Getting Rich in China: an Empirical and Structural Investigation of Wealth Mobility

Vincenzo Quadrini*, Qi Sun†, Junjie Xia‡, Ting Zeng§

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Abstract

We study the properties of individual wealth growth and mobility in China using the China Household Finance Survey and outline three findings. First, capital gains are the most important factor in generating wealth mobility while individual savings play a minor role. Second, housing is very important for wealth mobility due to the high share of houses in household portfolios and the large cross-sectional dispersion in the growth of housing prices. Third, wealth mobility increases with debt. To explore the implications of changes in the structure of financial markets for wealth distribution and mobility in China, we construct a general equilibrium model with three types of assets: housing, stock market and risk-free bonds. One of the explored structural changes is the government sale of SOE's shares (privatization). This reduces wealth inequality but also capital accumulation.

Introduction

It is well known that wealth is highly concentrated. Much more concentrated than earnings, income and consumption. However, the properties of wealth

*University of Southern California and CEPR, e-mail: quadrini@usc.edu
†Shanghai University of Finance and Economics, e-mail: sunqi@sufe.edu.cn
‡Peking University, e-mail: junjiexia@nsd.pku.edu.cn
§Southwestern University of Finance and Economics, e-mail: zeng-ting@hotmail.com

mobility—that is, the change in individual wealth over time—are less known. This is because longitudinal data that tracks individual assets over time is more limited than cross-sectional data. As a result, most empirical studies focus on cross-sectional comparisons which, unfortunately, do not inform us about the movement of individuals within the distribution of wealth. In this paper we take advantage of the longitudinal features of the China Household Finance Survey (CHFS) to characterize the properties of wealth mobility in China.

The CHFS is similar to the Survey of Consumer Finances (SCF) but with the additional longitudinal structure that allows us to keep track of the same household over time. Also, it collects information on consumption expenditures which is important for computing individual savings. The survey has been conducted every two years, since 2011. There are several studies that have used the cross-sectional dimension of the CHFS but very few explore the longitudinal structure of the survey to study wealth mobility. One exception is Zeng and Zhu (2019) who documented preliminary facts on earning, income, and wealth mobility for the upper income groups. That study, however, does not conduct a detailed analysis of the driving forces underlying wealth mobility.

The main goal of our paper is to identify some of the factors that facilitate the change in household wealth over time, and the empirical analysis outlines three main findings. First, individual savings play a minor role in accounting for wealth mobility. Although households with higher rates of saving tend to experience higher growth rate of wealth, saving heterogeneity across households explains only a small fraction of the variation in individual wealth growth. Instead, the most important force underlying the heterogeneity in individual wealth growth is the large dispersion in capital gains. The fact that there is large dispersion in capital gains indicates that households' wealth is very undiversified.

The second finding is that housing ownership is very important for wealth mobility. This is a consequence of two features of the Chinese economy. First, household wealth is mostly in housing, about 70 percent. This is larger than in advance economies like the United States. Second, there is significant cross-sectional dispersion in capital gains on housing. While the importance of housing wealth for Chinese households is well known, the large dispersion in housing capital gains and their importance for wealth mobility is relatively new. These two empirical facts—large share of housing wealth and large dispersion in housing capital gains—further indicate that households' wealth is very undiversified in China and exposed to large idiosyncratic risks.

The third finding is the importance of households' debt for wealth mobility. Households that borrow more (higher leverage) tend to experience greater volatility of wealth growth. This finding is intuitive since leverage increases the volatility of net worth in the same way it does for leveraged firms. Although household borrowing is not very diffuse in China, those who borrow do experience greater volatility of wealth growth.

To summarize, we find that housing ownership and leverage are key factors in explaining individual wealth mobility in China. Households that allocate a larger fraction of their wealth in housing and finance their investments with debt are more likely to experience mobility—both upward and downward—due to the large idiosyncratic dispersion in housing capital gains.

The empirical findings raise several questions. If housing ownership is so risky, why do Chinese households allocate so much wealth in housing? Of course, this depends on the availability of alternative saving instruments such as corporate shares. Although the privatization of the Chinese economy has gone a long way, public ownership of enterprises is still sizable relatively to the whole economy. This limits the volume of corporate shares available to the private sector as a form of investment instruments and raises the following question: how does the privatization of state-owned enterprises affects portfolio holdings, inequality and mobility? Also, what would be the implications of financial development allowing for greater households' access to debt?

To address these questions we built a general equilibrium model where households can save in three assets: housing, stock market and bonds (or debt). Housing carries aggregate and, importantly, also idiosyncratic risks. The stock market carries only an aggregate risk (since the stock market is more diversified than housing). Bonds (or debt) have no risk.

After calibrating the model to the Chinese economy, we conduct two experiments. In the first we relax the financial constraints faced by households which allows for higher borrowing. The consequences of higher borrowing is an increase in wealth inequality. It also increases wealth mobility but only for borrowing households. In terms of macroeconomic effects, greater access to credit increases capital accumulation and aggregate production. In the second experiment we consider a reform in which the government privatizes state-owned enterprises. An implication of the privatization is that it increases the saving instruments available to the private sector and this allows for greater diversification of the idiosyncratic risk. Remember that the stock market return carries aggregate risks but not idiosyncratic risks. Preliminary results suggest that such a reform reduces both inequality and mobility. The effects on capital accumulation and aggregate production, however, are negative. The two exercises highlight a trade-off between equality and macroeconomic performance. Greater accessability to credit and higher public ownership of productive capital have positive macroeconomic effects. However, they are also associated with greater inequality.

1 Empirical analysis

The main goal of the empirical analysis is to relate the growth rate of individual wealth—denoted by g_{wt}—to economically relevant variables. We first derive an expression that decomposes the growth rate of wealth in few components (Subsection 1.1). We will then use the data to explore how these components are related to the variables of interest (Subsection 1.2).

1.1 Accounting framework

Denote by W_t the net worth of an individual household at time t. We will also refer to W_t simply as 'wealth'. The growth rate of wealth between t and $t+1$, denoted by $g_{wt} = W_{t+1}/W_t - 1$, can be decomposed as follows:

$$\begin{aligned} g_{wt} &= \frac{g_t W_t}{W_t} + \frac{Y_t - C_t}{Y_t}\frac{Y_t}{W_t} \\ &= g_t + s_t r_t^W. \end{aligned} \tag{1}$$

The variable g_t is the capital gain on each unit of wealth, $s_t = \frac{Y_t - C_t}{Y_t}$ is the saving rate (with Y_t and C_t denoting, respectively, income and consumption), and $r_{wt} = \frac{Y_t}{W_t}$ can be thought as a broad return on wealth with the exclusion of capital gains. The broad concept of return includes also income from labor as if earnings were generated by wealth.

We can further decompose the broad return—net of capital gains—into the return coming from capital income and the return coming from labor income, that is, $r_{wt} = \frac{Y_t^K + Y_t^L}{W_t} = r_t^K + r_t^L$. The variables Y_t^K and Y_t^L are, respectively, capital and labor incomes earned by an individual household. We can then rewrite the decomposition of wealth growth as

$$g_{wt} = g_t + s_t(r_t^K + r_t^L) \tag{2}$$

Equations (1) and (2) represent the basic mathematical framework we use in our empirical analysis.

1.2 Data source

The main source of data is China Household Finance Survey (CHFS). The survey has been conducted bi-annually starting in 2011 and there are five waves available: 2011, 2013, 2015, 2017, 2019. However, since the measurement of consumption in the 2019 survey is not fully consistent with the previous years, we do not use the latest 2019 survey. A feature of the CHFS is that it samples the same households in different years, which allows us to track individual wealth over time. These dynamic features are studied by linking the 2011-2013 waves, the 2013-2015 waves, and the 2015-2017 waves. Although the cross-sectional aspects of the data has been used by other researchers, the use of the longitudinal dimension for the study of wealth mobility is fairly new.

There are some issues related to the timing in which income and wealth are measured in the survey. Wealth and its components (assets and liabilities) are observed in the middle of the survey years, that is, 2011, 2013, 2015 and 2017. Income and consumption, instead, are for the year that precedes the survey year. This implies that income and consumption are available for the years 2010, 2012, 2014 and 2016 but not for years 2011, 2013, 2015 and 2017. To circumvent this problem, we proxy income and consumption for the missing years with the average of two adjacent years. Specifically, the proxy for 2011 is the average of 2010 and 2012; for 2013 we use the average of 2012 and 2014; for 2015 we use the average of 2014 and 2016.

The statistics that will be reported in the paper are based on the urban sample which is thought to be more accurate and affected by smaller measurement errors. This is especially important for the value of housing wealth. However, the inclusion of the rural sample does not change in important ways the main results of the paper. The results for the whole sample are available upon request.

Mobility analysis is typically done with the construction of transition matrices. For a group of households located in a particular wealth class today (for example, in the first quintile), the transition matrix reports the distribution of this class in next period (that is, the percentage of households located in each of the wealth quintile next period). But ultimately, in order to move from one wealth class to the other, a household needs to experience growth in wealth. Therefore, in this study, we complement the analysis based on transition matrices with the analysis of growth using the decompositions outlined in equations (1) and (2).

Table 1 reports statistics based on the decomposition of wealth growth of equations (1) and (2). We first sort households into five quintiles based on the growth rate of net wealth (assets minus liabilities). Then, for each group, we calculate group-level aggregate variables and use them to compute the statistics of interest. For example, for each quintile, we first calculate the group income $y_{qt} = \sum_{i \in q} \omega_{it} y_{it}$ and group consumption $c_{qt} = \sum_{i \in q} \omega_{it} c_{it}$, where ω_{it} is the survey weight assigned to household i. We then compute the group-level saving rate as $s_{qt} = \frac{y_{qt} - c_{qt}}{y_{qt}}$. The same approach is used to calculate the growth of wealth and the return on wealth.

Table 1 shows that there are large differences in wealth growth rate among households. For example, focusing on the 2015-2017 panel, we see that during these two years the top quintile experienced an average growth rate of 184.9%. For the bottom quintile, instead, the average growth rate was -80.1%. A similar variation among the five groups is observed for capital gains. These numbers already indicate that the major source of variation for wealth growth comes from capital gains. In the appendix, we also report the results by sorting households according to their initial wealth as well as the average wealth over the two survey years (Tables 21 and 22).

1.3 Variance decomposition of wealth growth

We conduct a variance decomposition analysis for the growth rate of wealth using equation (1). For convenience we rewrite the equation here as

$$g_{wt} = 1 + \text{capital gain}_t + \text{saving}_t. \tag{3}$$

The variance decomposition allows us to determine the importance of capital gains and savings for the dispersion of wealth growth. The results for each of the linked surveys are reported in the top section of Table 2. As can be seen, most of the variation in wealth growth can be attributed to capital gains as they account for more than 80% of the variance of wealth growth.

Table (2) computes the variance decomposition for different sub-samples. We first separate households with and without housing debt. We then separate households that own one house from households that own multiple houses. Notice that by splitting the sample, we eliminate between-group variations.

Table 1: **Wealth growth across households (sorted by growth rates).**

	obs	g_{wt}	g_t	s_t	r_{wt}	r_{lt}	r_{kt}
2011-2013							
Whole sample	3,705	19.4%	14.4%	26.8%	18.9%	11.9%	7.0%
Quintile 1	708	-59.3%	-61.3%	18.2%	11.0%	7.3%	3.7%
Quintile 2	733	-9.1%	-12.9%	25.0%	15.3%	9.9%	5.4%
Quintile 3	745	23.2%	17.3%	32.6%	18.2%	11.5%	6.7%
Quintile 4	735	63.8%	57.3%	27.4%	23.8%	15.0%	8.8%
Quintile 5	784	216.3%	204.5%	28.3%	41.5%	24.4%	17.1%
2013-2015							
Whole sample	12,851	11.8%	7.2%	24.8%	18.5%	11.5%	7.1%
Quintile 1	2,749	-65.6%	-67.4%	15.0%	12.0%	8.6%	3.4%
Quintile 2	2,520	-17.0%	-20.7%	24.5%	15.3%	9.7%	5.6%
Quintile 3	2,459	10.2%	5.6%	27.1%	17.3%	10.8%	6.5%
Quintile 4	2,542	48.8%	42.8%	27.5%	21.9%	13.2%	8.8%
Quintile 5	2,581	187.9%	177.8%	27.0%	37.1%	20.4%	16.7%
2015-2017							
Whole sample	15,742	13.8%	8.0%	30.0%	19.1%	11.8%	7.3%
Quintile 1	3,111	-80.1%	-82.0%	15.9%	12.3%	8.0%	4.3%
Quintile 2	3,068	-30.7%	-34.9%	27.2%	15.7%	10.2%	5.5%
Quintile 3	2,969	8.3%	2.2%	32.0%	18.9%	11.6%	7.3%
Quintile 4	3,300	50.1%	43.1%	33.9%	20.5%	12.6%	7.8%
Quintile 5	3,294	184.9%	173.3%	34.3%	33.8%	19.5%	14.3%

The table shows that capital gains account for a larger share of variance when we use the sub-sample of households that have housing debt and have multiple houses. This suggests that borrowing against the owned house and owning multiple houses are important for wealth mobility.

Next we conduct a variance decomposition after sorting households in quintiles based on their initial wealth. The results are reported in Table 3. Since the wealth quintiles are calculated based on the initial wealth (for example, for the 2015-2017 matched samples, households are sorted based on 2015 wealth), low wealth households tend to grow faster and, mechanically, they have higher variance. But the key message is that capital gains are the

Table 2: **Variance decomposition of wealth growth.**

	Whole sample			
	Std	Gain	Save	Cov
2011-2013	1.18	81.63%	2.69%	15.68%
2013-2015	1.10	83.09%	0.95%	15.96%
2015-2017	1.07	83.92%	3.24%	12.83%

	Without housing debt				**With housing debt**			
	Std	Gain	Save	Cov	Std	Gain	Save	Cov
2011-2013	1.17	79.28%	2.66%	18.06%	1.21	93.84%	3.07%	3.08%
2013-2015	1.10	82.45%	0.74%	16.80%	1.08	86.89%	2.62%	10.49%
2015-2017	1.05	82.51%	2.63%	14.86%	1.12	90.09%	5.87%	4.04%

	One-house owner				**Multiple-house owner**			
	Std	Gain	Save	Cov	Std	Gain	Save	Cov
2011-2013	1.12	74.34%	1.95%	23.71%	0.84	94.60%	0.08%	5.32%
2013-2015	0.99	77.45%	0.53%	22.01%	0.73	94.50%	0.29%	5.21%
2015-2017	1.01	79.54%	1.85%	18.61%	0.78	94.72%	4.23%	1.06%

most important force for the volatility of growth for each wealth class and they increase with wealth.

Table 3: **Variance decomposition of wealth growth for different quintiles based on initial wealth. Linked surveys 2015-2017.**

	Std	Gain	Save	Cov
Quintile 1	1.42	68.22%	3.64%	28.15%
Quintile 2	1.05	92.71%	2.64%	4.66%
Quintile 3	0.93	95.16%	3.22%	1.62%
Quintile 4	0.92	97.18%	4.04%	-1.22%
Quintile 5	0.79	98.78%	4.23%	-3.00%

Another way to look at the role of housing and housing debt in generating wealth mobility is with the construction of wealth mobility matrices. Table 4 reports the wealth mobility matrices for the full samples and the sub-samples of households with housing debt and multiple houses. The thresholds used to calculate the mobility matrices in the sub-samples remain the same as those used for the whole sample. For economy of space we report only the transition matrices for the last linked waves, 2015-2017. The transition matrices constructed with the previous surveys are provided in the appendix.

Comparing the transition matrices for the whole sample and the two sub-samples, we find that households with housing debt and multiple houses are more likely to move upward and less likely to move downward. As we will see, this property is consistent with the later regression analysis.

Table 4: **Wealth mobility matrices for whole sample and sub-samples with housing debt and multiple houses. Linked surveys 2015-2017.**

Whole sample (2011-2013)			
	Bottom	Middle	Top
Bottom	64.0%	30.9%	5.0%
Middel	18.5%	54.4%	27.1%
Top	7.1%	16.2%	76.7%

With housing debt (2011-2013)			
	Bottom	Middle	Top
Bottom	45.2%	44.2%	10.5%
Middle	11.1%	50.4%	38.5%
Top	5.5%	14.3%	80.2%

With multiple houses (2011-2013)			
	Bottom	Middle	Top
Bottom	60.3%	34.9%	4.8%
Middle	17.0%	49.5%	33.5%
Top	4.9%	15.3%	79.8%

1.4 The role of capital gains on housing

We further decompose the capital gains into gains from housing and gains from other assets. To do so, we rewrite the wealth growth equation as:

$$\mathrm{d}W = H\mathrm{d}p + A\mathrm{d}q + S, \tag{4}$$

where $\mathrm{d}W$ is the growth of wealth (net worth). The variable H denotes the size of housing assets, p the price of houses, A the size of other assets and q the price of these other assets. Thus, $H\mathrm{d}p$ is the capital gain from owning houses, $A\mathrm{d}q$ is the capital gain from other assets, and S is saving.

We measure the capital gains on housing using the total change in the value of owned houses, that is, $\mathrm{d}(Hp)$. However, this is a correct measure of capital gains only for households who keep the same house or houses over the two-year period. In this case we have that $H\mathrm{d}(p) = \mathrm{d}(Hp)$. For households that change houses during the two-year period, we are unable to separate the part of the change in housing value that can be attributed to capital gains. For that reason we also consider the restricted sample containing households who keep the same houses.

Table 5 shows the percentage variance attributable to each component of wealth (housing, other assets and savings). The top section is for the whole sample, while the bottom section is for the restricted sample of households who did not change houses over the two-year period (they kept the same H). As can be seen from the table, capital gains on housing is the predominant source of variation for wealth growth.

Table 5: **Variance decomposition of wealth growth.**

	Housing assets $\frac{\mathrm{Var}(H\mathrm{d}p)}{\mathrm{Var}(\mathrm{d}W)}$	Other assets $\frac{\mathrm{Var}(A\mathrm{d}q)}{\mathrm{Var}(\mathrm{d}W)}$	Savings $\frac{\mathrm{Var}(S)}{\mathrm{Var}(\mathrm{d}W)}$	Covariances $\frac{\mathrm{Cov}}{\mathrm{Var}(\mathrm{d}W)}$
		Whole sample		
2011-2013	53.42%	26.73%	2.69%	17.16%
2013-2015	67.37%	15.29%	0.95%	16.39%
2015-2017	70.05%	11.11%	3.24%	15.60%
		Fixed housing		
2011-2013	47.06%	34.10%	1.78%	17.06%
2013-2015	56.78%	23.76%	0.52%	18.94%
2015-2017	64.00%	17.12%	1.97%	16.91%

One of the reasons capital gains on housing play such a dominant role for the volatility of wealth growth is because housing represents the largest component of household wealth. As shown in Table 6, housing accounts for more than 70 percent the value of households' total assets.

1.5 Regression analysis

So far we have shown that capital gains and, especially, those on housing, are the main cause of cross-sectional variation in wealth growth. In this section we provide more evidence about the determinants of wealth growth (mobility) using regression analysis. We consider five dependent variables:

Table 6: **The share of housing assets in total assets. Quitile sorting based on growth rate of wealth.**

	obs	$\frac{\text{hs-asset}}{\text{asset}}$	$\frac{\text{fin-asset}}{\text{asset}}$	$\frac{\text{bus-asset}}{\text{asset}}$	$\frac{\text{oth-asset}}{\text{asset}}$	$\frac{\text{t-debt}}{\text{asset}}$	$\frac{\text{hs-debt}}{\text{asset}}$
	Asset composition in 2015						
all	15,742	69.14%	13.23%	10.75%	6.88%	4.99%	2.97%
Quintile 1	3,111	59.16%	9.32%	23.62%	7.90%	4.47%	1.74%
Quintile 2	3,068	65.24%	14.65%	12.12%	7.98%	4.31%	1.95%
Quintile 3	2,969	71.05%	15.93%	6.90%	6.12%	3.68%	2.24%
Quintile 4	3,300	77.05%	13.39%	3.94%	5.62%	5.11%	3.66%
Quintile 5	3,294	77.03%	12.77%	3.62%	6.59%	9.23%	7.05%
	Asset composition in 2017						
all	15,742	75.48%	12.46%	5.62%	6.44%	6.24%	3.85%
Quintile 1	3,111	61.55%	16.83%	7.80%	13.82%	34.84%	11.57%
Quintile 2	3,068	72.87%	13.56%	5.60%	7.97%	6.17%	3.79%
Quintile 3	2,969	74.18%	12.98%	6.22%	6.62%	5.13%	3.57%
Quintile 4	3,300	78.58%	12.25%	3.80%	5.37%	4.10%	3.08%
Quintile 5	3,294	76.55%	11.29%	6.48%	5.68%	5.15%	3.72%

Notes: hs=housing; fin=financial; bus=business; oth=other; t=total.

1. g_w: growth rate of wealth.

2. $P(g_w^{High})$: probability of being in the top 33% of wealth growth.

3. $P(g_w^{Low})$: probability of being in the bottom 33% of wealth growth.

4. $P(up)$: probability of moving out of the bottom 33% of wealth growth.

5. $P(down)$: probability of moving out of the top 33% of wealth growth.

We regress these variables on several indicators with results reported in Table (7). For simplicity we report only results for the most recent survey years. Resuts for earlier years are similar. The first column is for the regression with wealth growth as dependent variable. As can be seen, wealth growth is negatively correlated with initial wealth and positive correlated with savings. These correlations have intuitive interpretations: the initial wealth has a negative effect on growth due to 'mean-reversal', while savings raise next period wealth by definition.

More importantly, we find that wealth growth is positively associated with housing. Wealth increases more if households has multiple houses, purchased new houses during the sample period or had houses with increasing housing prices. We use the term 'newly purchased houses' for households who purchased a house during the sample period and 'housing appreciation' for households who owned at least one house and whose house price increased more than 50% during the sample period. We also find that wealth growth is positively correlated with education and it has an inverse U-shape relation with age. Finally, the ownership of a business has a positive impact on the growth rate of wealth.

The second column of Table 7 is for the regression where the dependent variable is the probability of experiencing high growth of wealth. Both the housing variables and business ownership have positive effects on this variable. The also have a positive impact on the probability of moving to the upper group as shown in the fourth column of Table 7. The housing variables are also significant in explaining the probability of low wealth growth but with the opposite sign. These results show that housing is an important factor for wealth mobility in China.

Table 7 also shows that housing debt is important for mobility: households with higher debt experience higher growth of wealth, have higher probability of moving up and lower probability of moving down in distribution of

Table 7: **The impact of housing debt on wealth growth.**

	(1) g_w	(2) $P(g_w^{High})$	(3) $P(g_w^{Low})$	(4) $P(\text{up})$	(5) $P(\text{down})$
Lag wealth	-0.35***	-0.12***	0.06***	-0.10***	0.07***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
Saving	0.55***	0.17***	-0.19***	0.11***	-0.02***
	(0.05)	(0.02)	(0.02)	(0.02)	(0.00)
Lag housing debt	**1.81*****	**0.98*****	**-0.58*****	**0.48*****	**-0.07*****
	(0.19)	(0.09)	(0.08)	(0.08)	(0.03)
New purchased house	0.79***	0.31***	-0.18***	0.09***	-0.04***
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)
Housing appreciation	1.07***	0.52***	-0.33***	0.15***	-0.06***
	(0.03)	(0.01)	(0.01)	(0.01)	(0.00)
Multiple house owner	0.21***	0.04***	-0.13***	-0.04***	-0.06***
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)
Business owner	0.28***	0.08***	0.00	0.01	0.01
	(0.04)	(0.02)	(0.02)	(0.01)	(0.01)
Age	0.02***	0.01***	-0.01***	0.00	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age^2	-0.00***	-0.00***	0.00***	-0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
College	0.14***	0.05***	-0.08***	-0.00	-0.04***
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)
Family size	-0.02*	-0.01***	0.01***	-0.00	0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	4.10***	1.56***	-0.14*	1.37***	-0.73***
	(0.20)	(0.08)	(0.09)	(0.07)	(0.04)
Observations	15,551	15,551	15,551	15,551	15,551
R-squared	0.38	0.36	0.17	0.17	0.11

wealth. These findings show that borrowing against housing assets could be an important way to enhance the likelihood of moving up in the distribution of wealth. But how many households do actually borrow?

Table 8 shows that in 2017 only 16.4 percent of households had housing debt. Conditional on having housing debt, the average housing debt was only 13.48% the value of assets. As a percentage of income, the average housing debt was 193.22%. Similar statistics are found in other survey years. Therefore, even if debt could be important for mobility, only a small fraction of Chinese households borrow against their houses. Furthermore, the value of debt for those who borrow is relatively small. This points out that the financial structure of China is still in a development stage. Limited borrowing may be considered an impediment to enhance mobility. From a macro perspective, however, less debt may provide greater financial and macroeconomic stability.

Table 8: **Summary statistics for housing debt, 2017.**

	Obs	**Mean**	**Std. Dev.**	**Min**	**Max**
	Whole sample				
HouseDebt/Income	15,523	25.23%	65.64%	0.00%	247.39%
TotalDebt/Income	15,523	50.65%	109.10%	0.00%	399.93%
HouseDebt/Asset	15,742	2.40%	6.08%	0.00%	22.04%
TotalDebt/Asset	15,742	5.86%	12.16%	0.00%	43.80%
	Positive housing debt				
HouseDebt/Income	2,539	141.67%	87.75%	0.00%	247.39%
TotalDebt/Income	2,539	193.22%	137.94%	0.00%	399.93%
HouseDebt/Asset	2,584	13.48%	7.62%	0.00%	22.04%
TotalDebt/Asset	2,584	19.93%	14.18%	0.00%	43.80%

2 The model

The economy is populated by a unit mass of households, each surviving with probability $1 - \omega$. Exiting households are replaced by the same mass of newborn households so that population remains constant. Expected lifetime utility is

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \ln(c_t),$$

where $c_t = \hat{c}_t + \chi h_t$ is the sum of non-housing consumption, $\hat{c}_t$, and housing services χh_t (h_t is the stock of houses and χ is a constant parameter). In addition to housing services that enter directly the utility function, housing also generates income as we will describe below. The discount factor $\beta = \hat{\beta}\omega$ is the product of the inter-temporal discount factor $\hat{\beta}$ and the survival rate ω. Newborn households are endowed with the average states of surviving households.

Households are heterogeneous in human capital denoted by l_t. Each unit of human capital earns the w_t and evolves endogenously over time according to

$$l_{t+1} = \eta_t l_t + e_t.$$

The variable e_t is investment in human capital and η_t is an idiosyncratic shock that affects the current stock l_t.

We think of l_t as broadly defined and the earned income includes not only the typical wage but also profits from small undiversified businesses. Consistently with this broad definition, investment in human capital would also include investments in undiversified businesses.

The shock to human capital is independently and identically distributed with its mean normalized to 1, that is, $\mathbb{E}\eta_t = 1$. Even though the shock is iid, the income generated by human capital is very persistent since it affects the stock. As we will see, modelling labor (and business) earnings as an endogenous process implies that decision rules that linear in wealth. This is a convenient property because it allows for aggregation even if the model generates very complex heterogeneity.

Households hold three types of assets: housing, h_t, stock market, k_t, and bonds, b_t. Housing is in limited supply and traded at price P_t. An important assumption is that the return from housing depends on an idiosyncratic shock, in addition to the aggregate shock. The stock market represents diversified ownership of business capital and it is subject to the aggregate shock only. Differently from housing, capital is reproducible and without adjustment costs. This implies that its price is always 1 (although its return is stochastic). Bonds do not carry any risk and pay the gross return R_t. For an individual household bonds can be negative, in which case the household would be a borrower. Borrowing, however, is limited by the following collateral constraint

$$-b_{t+1} \leq \xi \Big(P_t h_{t+1} + \lambda k_{t+1} + l_{t+1} \Big). \quad (5)$$

The constraint depends on the value of houses, stock market and human capital. The latter is a proxy for incomes (especially from labor) that are also taken into consideration by lenders assess the credit-worthiness of borrowers. We also allow the stock market (business capital) to be used as a collateral. However, the collateral value of the stock market is likely to be lower than housing and human capital. This suggests that $\lambda < 1$.

The stock market generates cash flow $r_t^k k_t$, where r_t^k depends on aggregate productivity as specified below. Housing generates the cash flow $r_t^h h_t$, which also depends on aggregate productivity. In addition, houses are subject to idiosyncratic appreciation/depreciation: h_t units of houses purchased in the previous period become $\psi_t h_t$ units this period. The stochastic variable ψ_t is iid with its mean normalized to 1, that is, $\mathbb{E}\psi_t = 1$. We think of ψ_t as reflecting idiosyncratic local factors that can increase or decrease the value of a house relatively to the aggregate price P_t.

To capture heterogeneous participation in capital markets, we assume that households face heterogeneous costs for holding housing, stock market and human capital. More specifically, they incur the cost $\tau_t(h_{t+1}P_t + k_{t+1} + l_{t+1})$, where τ_t is an idiosyncratic stochastic variable that follows a finite-state Markov process. This implies that, at any point in time, households are heterogenous in τ_t. Those with a lower values of τ_t will participate more in these three markets and, in equilibrium, they will borrow from other households (those with higher values of τ_t).

Although in the model the lower participation of some households to financial markets is generated by a pecuniary cost, in reality it could derive from other factors. For example, it could be the reflection of limited financial literacy: not being fully knowledgeable about the functioning of certain markets may refrain some households from investing more in these markets. One of the goals of this paper is to explore how heterogeneous participation in high return markets impacts wealth distribution and mobility.

The budget constraint for an agent with investment cost τ_t is

$$c_t + (1+\tau_t)\Big[P_t h_{t+1} + k_{t+1} + l_{t+1} \Big] + b_{t+1} = R_t^h h_t + R_t^k k_t + R_t^l l_t + R_t b_t, \quad (6)$$

where R_t^h, R_t^k, R_t^l, R_t are the gross returns earned, respectively, on houses, stock market, human capital and bonds. Since $c_t = \hat{c}_t + \chi h_t$ includes housing services that enter directly the utility function, the return on housing R_t^h also includes these services as we will see more explicitly below.

We now have all the elements to define the optimization problem solved by an individual household. Given $\mathbf{x}_t = (\tau_t, \psi_t, \eta_t)$ the vector of idiosyncratic shocks, the household's problem can be written as

$$V_t(\mathbf{x}_t; h_t, k_t, b_t) = \max_{\substack{c_t, h_{t+1}, \\ k_{t+1}, b_{t+1}}} \left\{ \ln(c_t) + \beta \mathbb{E}_t V_t(\mathbf{x}_{t+1}; h_{t+1}, k_{t+1}, b_{t+1}) \right\}, \quad (7)$$

subject to the borrowing constraint—equation (5)—and the budget constraint—equation (6). The subscript t in the value function captures the dependence on aggregate states. The housing price P_t and the returns R_t^h, R_t^k, R_t^l, R_t are all determined in general equilibrium but they are taken as given by an individual household.

Production technology and returns. There is a continuum of competitive firms that run the production function

$$Y_t = z_t H_t^{\theta_H} K_t^{\theta_K} L_t^{\theta_L},$$

where H_t is the input of houses, K_t is the input of capital, L_t is the input of labor and z_t is an aggregate productivity shock. The share parameters satisfy $\theta_H + \theta_K + \theta_L = 1$ (constant return to scale).

The return from housing derive in part from its contribution to market production and in part from direct utility services to households. We include housing in the production function because housing services represent an important component of GDP. However, if this was the only return from housing, it would be impossible for the model to generate the high valuation of housing wealth observed in the data. By assuming that housing provides also utility services, we are able to match the share of housing wealth we observe in the portfolio of Chinese households.

Capital is held in part by the government, denoted by $K_{g,t}$, and in part by the private sector, denoted by $K_{p,t}$. Therefore, $K_t = K_{g,t} + K_{p,t}$. Through the choice of $K_{g,t}$, the government affects the stock market assets held by the private sector. Changes in government ownership is one of the policies we will study in this paper.

The optimality conditions are

$$\begin{aligned} r_t^h &= \theta_H z_t H_t^{\theta_H - 1} K_t^{\theta_K} L_t^{\theta_L}, \\ r_t^k &= \theta_K z_t H_t^{\theta_H} K_t^{\theta_K - 1} L_t^{\theta_L}, \\ w_t &= \theta_L z_t H_t^{\theta_H} K_t^{\theta_K} L_t^{\theta_L - 1}. \end{aligned}$$

The gross returns on housing, stock market and human capital are, respectively,

$$\begin{aligned} R_t^h &= r_t^h + \chi + \psi_t P_t, \\ R_t^k &= r_t^k + 1 - \delta, \\ R_t^l &= w_t + \eta_t. \end{aligned}$$

While r_t^h, r_t^k and w_t are subject to the aggregate shock z_t, the gross returns R_t^h and R_t^l depend also, respectively, on the idiosyncratic shocks ψ_t and η_t. This captures the fact that investments in housing and human capital are less diversified than investments in the stock market. Small businesses, of course, are also very undiversified. However, we think of small businesses as being part of the process that determines $w_t l_t$.

Government. The government earns income through the ownership of capital. The earned income is used to fund public consumption, G_t, and public investment, $K_{g,t+1} - (1-\delta)K_{g,t}$. The budget constraint is

$$G_t + K_{g,t+1} = R_t^k K_{g,t}. \tag{8}$$

Public consumption G_t generates benefits for households that are additive to their utility. Being additive to utility—rather than to private consumption—G_t does not affect households' first order conditions. Therefore, the explicit inclusion of this term in the specification of the utility function is not relevant.[1]

[1] The assumption that public services are additive to the utility of households, however, is important for the impact of a privatization policy. If public services were additive to private consumption instead of being additive to private utility, the government holding of capital would be irrelevant. The intuition is that a higher value of $K_{g,t}$ allows the government to provide a higher value of G_t. But since households hold less capital, they will have less private consumption. On the other hand, when $K_{g,t}$ is low, households will hold more capital and the lower G_t will be compensated by higher private consumption. Total consumption (private plus public) would be the same in these two cases. Effectively, public policy displays a Ricardian equivalence. This is not the case when G_t is additive to private consumption as we will see.

2.1 First order conditions and portfolio choices

The linear structure of the investment problem, including human capital, allows us to aggregate individual decisions for all households that have the same access to financial markets, that is, same value of τ_t. This property allows us also to reduce the number of individual states.

Define $a_t = R_t^h h_t + R_t^k k_t + R_t^l l_t + R_t b_t$. This is an 'extended' measure of net worth at the end of the period t. It is an extended measure because it includes the household's human capital as well as housing services that enter directly the utility function, χh_t. Using the variable a_t and taking into account that the idiosyncratic shocks ψ_t and η_t are iid, we can rewrite the problem solved by the household as

$$V_t(\tau_t; a_t) = \max_{c_t, h_{t+1}, \tilde{k}_{t+1}, l_{t+1}, b_{t+1}} \left\{ \ln(c_t) + \beta \mathbb{E}_t V_t(\tau_{t+1}; a_{t+1}) \right\}, \tag{9}$$

subject to:

$$c_t = a_t - (1+\tau_t)\Big[P_t h_{t+1} + k_{t+1} + l_{t+1}\Big] - b_{t+1} \tag{10}$$

$$a_{t+1} = R_{t+1}^h h_{t+1} + R_{t+1}^k k_{t+1} + R_{t+1}^l l_{t+1} + R_{t+1} b_{t+1} \tag{11}$$

$$-b_{t+1} \leq \xi\Big(P_t h_{t+1} + \lambda k_{t+1} + l_{t+1}\Big). \tag{12}$$

The iid properties of ψ_{t+1} and η_{t+1} allow us to replace the vector of state variables $\mathbf{x}_t = (\tau_t, \psi_t, \eta_t)$ with only τ_t.

After normalizing the household's problem by a_t, we can rewrite it as

$$\tilde{V}_t(\tau_t) = \max_{\substack{\tilde{c}_t, \tilde{h}_{t+1}, \tilde{k}_{t+1}, \\ \tilde{l}_{t+1}, \tilde{b}_{t+1}}} \left\{ \log(\tilde{c}_t) + \beta \mathbb{E}_t \tilde{V}_{t+1}(\tau_{t+1}) + \frac{\beta}{1-\beta} \mathbb{E}_t \log(g_{t+1}) \right\}, \tag{13}$$

subject to:

$$\tilde{c}_t = 1 - (1+\tau_t)\Big[P_t \tilde{h}_{t+1} + \tilde{k}_{t+1} + \tilde{l}_{t+1}\Big] - \tilde{b}_{t+1} \tag{14}$$

$$g_{t+1} = R_{t+1}^h \tilde{h}_{t+1} + R_{t+1}^k \tilde{k}_{t+1} + R_{t+1}^l \tilde{l}_{t+1} + R_{t+1} \tilde{b}_{t+1} \tag{15}$$

$$-\tilde{b}_{t+1} \leq \xi\Big(P_t \tilde{h}_{t+1} + \lambda \tilde{k}_{t+1} + \tilde{l}_{t+1}\Big), \tag{16}$$

where, $V_t(\tau_t; a_t) = \log(a_t)/(1-\beta) + \tilde{V}_t(\tau_t)$ and $g_{t+1} = a_{t+1}/a_t$.

The tilde sign denotes that the original variable has been normalized (divided) by a_t. For example, $\tilde{c}_t = c_t/a_t$ and $\tilde{h}_{t+1} = h_{t+1}/a_t$. Notice that the law of motion for net worth now defines the growth rate of a_t, which we denoted by g_{t+1}.

The first order conditions are

$$\tilde{h}_{t+1} \quad : \quad \frac{(1+\tau_t)P_t}{\tilde{c}_t} = \frac{\beta}{1-\beta}\mathbb{E}_t\left(\frac{R^h_{t+1}}{g_{t+1}}\right) + \mu_t \xi P_t, \tag{17}$$

$$\tilde{k}_{t+1} \quad : \quad \frac{1+\tau_t}{\tilde{c}_t} = \frac{\beta}{1-\beta}\mathbb{E}_t\left(\frac{R^k_{t+1}}{g_{t+1}}\right) + \mu_t \xi \lambda, \tag{18}$$

$$\tilde{l}_{t+1} \quad : \quad \frac{1+\tau_t}{\tilde{c}_t} = \frac{\beta}{1-\beta}\mathbb{E}_t\left(\frac{R^l_{t+1}}{g_{t+1}}\right) + \mu_t \xi, \tag{19}$$

$$\tilde{b}_{t+1} \quad : \quad \frac{1}{\tilde{c}_t} = \frac{\beta}{1-\beta}\mathbb{E}_t\left(\frac{R_{t+1}}{g_{t+1}}\right) + \mu_t, \tag{20}$$

where μ_t is the Lagrange multiplier associated with the collateral constraint.

These conditions are exactly the same for all households with the same investment cost τ_t. A different τ_t implies different (expected) returns on housing, stock market and human capital. Thus, households with different τ_t choose different compositions of portfolio, that is, different values of $\tilde{h}_{t+1}$, $\tilde{k}_{t+1}$, $\tilde{l}_{t+1}$ and $\tilde{b}_{t+1}$. In particular, households with higher investment cost choose positive values of $\tilde{b}_{t+1}$ and become lenders while households with lower investment cost chose negative values of $\tilde{b}_{t+1}$ and become borrowers. For borrowing households the collateral constraint could be binding or not binding. In the first case $\mu_t > 0$. In the second case $\mu_t = 0$. Differences in portfolio choices imply that agents experience different stochastic properties of wealth growth and, therefore, differences in wealth mobility.

If we multiply the first order conditions (22)-(25), respectively, by $\tilde{h}_{t+1}$, $\tilde{k}_{t+1}$, $\tilde{l}_{t+1}$, $\tilde{b}_{t+1}$ and we add them together, we obtain

$$\frac{1-\tilde{c}_t}{\tilde{c}_t} = \frac{\beta}{1-\beta}. \tag{21}$$

This implies that $\tilde{c}_t = 1-\beta$ or, equivalently, $c_t = (1-\beta)a_t$.

Defining $\tilde{\mu}_t = (1-\beta)\mu_t$ and substituting $\tilde{c}_t = 1-\beta$ in the first order conditions we obtain the following five equations,

$$
\begin{aligned}
(1+\tau_t)P_t &= \beta\mathbb{E}\left(\frac{R^h_{t+1}}{g_{t+1}}\right)+\tilde{\mu}_t\xi P_t, && (22)\\
1+\tau_t &= \beta\mathbb{E}\left(\frac{R^k_{t+1}}{g_{t+1}}\right)+\tilde{\mu}_t\xi\lambda, && (23)\\
1+\tau_t &= \beta\mathbb{E}\left(\frac{R^l_{t+1}}{g_{t+1}}\right)+\tilde{\mu}_t\xi, && (24)\\
1 &= \beta\mathbb{E}\left(\frac{R_{t+1}}{g_{t+1}}\right)+\tilde{\mu}_t, && (25)\\
\tilde{\mu}_t &= 0, \qquad \text{if} \quad -\tilde{b}_{t+1}<\xi_t(P_t\tilde{h}_{t+1}+\lambda\tilde{k}_{t+1}+\tilde{l}_{t+1}), && (26)
\end{aligned}
$$

where $g_{t+1}=R^h_{t+1}\tilde{h}_{t+1}+R^k_{t+1}\tilde{k}_{t+1}+R^l_{t+1}\tilde{l}_{t+1}+R_{t+1}\tilde{b}_{t+1}$. Given the price P_t and the returns, this provides a dynamics system of five (first order difference) equations in five variables: h_t, k_t, l_t, b_t, and μ_t. For each individual state τ_t, then, we can derive explicit solutions for $\tilde{h}_{t+1}$, $\tilde{k}_{t+1}$, $\tilde{l}_{t+1}$, $\tilde{b}_{t+1}$, and $\tilde{\mu}_t$. Because of the normalization, the solutions are independent of a_t.

2.2 General equilibrium and numerical solution

The housing price P_t is an object that needs to solve in general equilibrium. We indicate the solution as $P_t=\mathcal{P}(\mathbf{s}_t)$ since it is a function of the aggregate states $\mathbf{s}_t$.

Assuming that τ_t takes I possible values, there are I groups or types of households, each characterized by a particular realization of τ_t. Households in each group also differ in the endogenous states. However, to characterize the general equilibrium, we only need the aggregate values of the endogenous states for each group. We denote the group-specific aggregates by $H_{i,t}$, $K_{i,t}$, $L_{i,t}$, $B_{i,t}$, with $i=1,...,I$. Even if a household is in group i today, it may be in a different group in the next period because τ_t changes stochastically. Thus, the sufficient states needed to solve for the equilibrium are $\mathbf{s}_t=\big\{z_t,\{H_{i,t},K_{i,t},L_{i,t},B_{i,t}\}_{i=1}^I\big\}$.

Given the structure of the model, we can further reduce the sufficient number of aggregate states by defining the variable

$$N_{i,t}=(r^h_t+\chi)H_{i,t}+R^k_tK_{i,t}+\bar{R}^l_tL_{i,t}+R_tB_{i,t},$$

where $\bar{R}_t^l$ is the gross return on human capital averaged over the idiosyncratic shock η_t, that is, $\bar{R}_t^l = \int_\eta R_t^l f(\eta) d\eta$. The new variable $N_{i,t}$ is the aggregate net worth for group i, including human capital, but with the exclusion of housing wealth $P_t H_{i,t}$. More specifically, $N_{i,t} = A_{i,t} - P_t H_{i,t}$, where $A_{i,t}$ is the aggregation of the extended net worth for group i. We can then redefine the sufficient set of aggregate states that are necessary to define the equilibrium as $\mathbf{s}_t = \left\{ z_t, \{H_{i,t}, N_{i,t}\}_{i=1}^I \right\}$.

If we knew the price function $\mathcal{P}(.)$, we could predict the next period price $P_{t+1} = \mathcal{P}(\mathbf{s}_{t+1})$ for each realization of the next period states $\mathbf{s}_{t+1}$. This would allow us to solve for the general equilibrium at any time t. However, since we do not know $\mathcal{P}(.)$, finding this function will be an important step in the computation of the equilibrium.

In practice, to find the price function, we need to approximate $\mathcal{P}(.)$ with some known functional form. We use the following approximation

$$P_{t+1} = \sum_j^J \alpha_{j,D} D_{j,t+1} + \sum_{i=1}^{I-1} \alpha_{i,H} H_{i,t+1} + \sum_{i=1}^{I} \alpha_{i,N} N_{i,t+1} \tag{27}$$

where $D_{j,t+1}$ is the dummy variable for the $j \in \{1, ..., J\}$ realization of aggregate productivity z_{t+1}. The numerical procedure will solve for the coefficients $\alpha_{j,D}$, $\alpha_{i,H}$, $\alpha_{i,N}$. Notice that the second summation on the right-hand-side of (27) contains only $I-1$ terms. This is because aggregate housing is constant in the model. The detailed procedure is described in Appendix A

3 Quantitative analysis

We first calibrate the model and then we will conduct counterfactual exercises to assess the quantitative implications of various structural changes. In particular, we consider changes in financial development that take the form of greater access to credit and/or wider financial participation. We will also assess the implications of government policies that privatize the ownership of state-owned enterprises.

3.1 Calibration

Since the CHFS is conducted every two years and some of the statistics we use to calibrate the model require merging two consecutive surveys (for example, to compute the growth rate of individual wealth), the period in the model is two years.

The production function is Cobb-Douglas, $Y_t = z_t H_t^{\theta_H} K_t^{\theta_K} L_t^{\theta_L}$, with share parameters $\theta_H = 0.15$, $\theta_K = 0.51$ and $\theta_L = 0.34$. The income share of housing, 15 percent, is higher than the value of rental income reported in the official Chinese statistics. However, the general view is that the official number underestimates the actual income generated by housing, which explains the higher number chosen for the calibration. Abstracting from housing, the data suggests that capital income accounts for about 60% and labor income for 40%. Therefore, we set $\theta^K = 0.85 \times 0.6 = 0.51$ and $\theta_L = 0.85 \times 0.4 = 0.34$. The depreciation rate of capital over the two-year period is $\delta = 0.15$. Since in the quantitative exercise we focus on long-term averages, we consider the version of the model without aggregate shocks and normalize z_t to 0.5.

The model features three idiosyncratic shocks: ψ_t, η_t and τ_t. We assume that the first shock is iid and can take five different values with equal probability. We then use data on the cross-sectional distribution of the growth rate in housing prices to assign the five values. More specifically, we first compute the growth rate in housing price for each household between 2013 and 2015 using the 2013 and 2015 waves. We then order households according to their individual growth rate and arrange them in quintiles. The five values of ψ are determined using the deviation of the average growth rate of each quintile from the sample mean. Mathematically, given g^i the average growth rate for decile $i = 1, ...5$, we set $\psi^i = 1 - (g^i - \sum_{i=1}^{5} g^i)$. We do the same for 2015-2017 and then we average the values of ψ^i obtained using the 2013-2015 data and the 2015-2017 data.

To calibrate the shock to human capital, η_t, we use the same procedure. We first construct quintiles for the growth rate of labor and business incomes, using data for 2013-2015 and data for 2015-2017. After calculating the deviation from the sample mean of each quintile, we average the quintile values η_t^i obtained from the 2013-2015 data and from the 2015-2017 data. The resulting numbers are reported in Table 9.

Table 9: **Distribution of growth in housing prices and earnings**

	1st	2nd	3rd	4th	5th
Housing price growth (ψ)	0.568	0.875	0.963	1.076	1.516
Labor earning growth (η)	0.568	0.875	0.963	1.076	1.516

The remaining idiosyncratic shock is the investment cost τ_t. We assume that τ_t follows a two-state Markov process. We further assume that the lower value, $\underline{\tau}$, is zero. This implies that in every period, a fraction of households can access high return investments without incurring any cost. This is without loss of generality because what matters is not the absolute values of $\underline{\tau}$ and $\bar{\tau}$ but their difference. Thus, setting $\underline{\tau} = 0$ can be considered a normalization.

With these restrictions, we only need to calibrate the high value $\bar{\tau}$ and the transition probabilities. Since in the model households with $\tau_t = \underline{\tau}$ borrow while households with $\tau_t = \bar{\tau}$ do not borrow, to calibrate the transition probabilities we us the fraction of households that in the data have a positive value of debt (specifically housing debt). We then compute the two-year households' transition from borrowing (positive housing debt) to not borrowing (zero housing debt). The two-year transition matrix, averaged over 2013-2015 and 2015-2017, is reported in Table 10. The matrix implies that the steady state fraction of borrowing households—which in the model are households with low investment cost—is about 15 percent.

Table 10: **Two-year transition matrix** $\Gamma(\tau_t, \tau_{t+1})$

	Borrowing	Not borrowing
Borrowing	0.52	0.48
Not borrowing	0.08	0.92

To calibrate the last parameter pertaining to the investment cost, $\bar{\tau}$, we use conditions (24) and (26). Agents with $\tau_t = \bar{\tau}$ do not borrow. Therefore, $\tilde{\mu}_t = 0$. Since we are considering the steady state without aggregate shocks, R^k_{t+1} is not stochastic. Conditions (24) and (26) then imply that

$$1 + \bar{\tau} = \frac{R^k_{t+1}}{R_{t+1}}.$$

Thus, $\bar{\tau}$ is directly related to the spread between the average return on the stock market, R^k_{t+1}, and the interest rate on bonds, R_{t+1}. We set the biannual spread (since the period in the model is two years) to 14%, which is in line with financial data for China.

At this point we are left with five parameters: the utility from owning houses, χ, the collateral parameters, ξ and λ, the discount factor $\hat{\beta}$ and the death probability ω (remember that $\beta = \omega\hat{\beta}$). In addition, we need to fix the stock of physical capital held by the government.

We do not have direct evidence that allows us to pin down the parameter λ. Therefore, we simply set it to 0.5. This means that the collateral value of stock market assets is 50% lower than the collateral value of houses. After fixing λ, we calibrate the remaining four parameters together with the government ownership of business capital jointly to match the following empirical moments: (i) the share of housing in households' portfolio is 70%; (ii) the aggregate debt over (two-year) output is 15%; (iii) the Gini index for wealth is 0.7; (iv) the (two-year) interest rate is 6% ($R_{t+1} = 1.06$); (v) the stock of capital held by the government is 50%.

The first three moments are computed from CHFS data. The four moment comes from Chinese financial data. The four moment is an approximation to the capital controlled by SOEs. In terms of value added, Chinese SOEs account for less than 50 percent. However, SOEs tend to be capital intensive, which explains our choice for the higher number. The full set of parameter values are reported in the top section of Table 11, while the bottom section reports some steady state statistics.

3.2 Steady state statistics

Most of the statistics reported at the bottom section of Table 11 are calibration targets. For example, we impose that the model generates a wealth Gini of 0.7. The other distributional statistics, however, are not targeted in the calibration. In particular, in the last row of the table we can see that the share of wealth held by the top 1 percent of households is 27.7%. This is higher than the share computed from the CHFS. We would like to point out, though, that the CHFS survey misses the super wealthy in China. Accounting for them may increase the concentration statistics at the very top of the distribution.

One modeling feature of interest is the participation in investment markets which is determined by the cost τ_t. This follows a two-state Markov process. At any point in time about 85% of households face the high cost $\bar{\tau} = 0.14$ while the remaining 15% face the low cost $\underline{\tau} = 0$. This cost affects the portfolio choices made by households, which in turn affect wealth mobility as shown in Table 12.

Households with low investment cost allocate a larger fraction of their wealth in housing, stock market and human capital. Their bond ownership is negative, meaning that they borrow from households that face a high investment cost. Because they allocate a larger share of wealth in high return

Table 11: **Calibration and steady state statistics**

Calibration value	
Discount factor	$\beta = 0.8985$
Death probability	$\omega = 0.0116$
Utility from housing	$\chi = 0.028$
Aggregate productivity	$\bar{z} = 0.5$
Income shares	$\theta_H = 0.15$, $\theta_K = 0.51$, $\theta_L = 0.34$
Capital depreciation	$\delta = 0.15$
Collateral parameter	$\xi = 0.176$
Collateral on k	$\lambda = 0.5$
Investment cost	$\tau_t \in \left\{0, 0.1321\right\}$, $\Gamma(\tau_t, \tau_{t+1}) = \begin{bmatrix} 0.92 & 0.08 \\ 0.48 & 0.52 \end{bmatrix}$
Housing shocks	$\psi_t \in \left\{0.5686, 0.8756, 0.9636, 1.0761, 1.5161\right\}$
Labor earning shocks	$\eta_t \in \left\{0.4544, 0.8534, 1.0114, 1.1704, 1.5104\right\}$
Steady state statistics	
House price	0.172
Output	0.082
Debt-Output ratio	0.151
Privately owned capital	0.060
Publicly owned capital	0.060
Housing share in wealth	0.695
Return on bonds	0.060 (3% annually)
Return on stock market	0.199 (10% annually)
Wealth Gini	0.699
Top percentiles of wealth	0.458 (top 5%), 0.277 (top 1%), 0.135 (top 0.1%)

assets (housing, stock market and human capital), the average growth rate of wealth is much higher than for households with high investment cost. At the same time, because they allocate a larger share of wealth in high volatile investments (housing and human capital), they experience greater standard deviation of growth. Thus, low cost households are characterized by higher upward mobility (higher average rate of wealth growth) but also higher overall mobility (both up and down).

The cost τ_t is just a simple way of capturing participation in investment markets. The numbers reported in Table 12 suggest that participation in these markets is an important mechanism for understanding wealth distribution and mobility.

Table 12: **Portfolio composition and property of wealth growth**

	Portfolio composition				Wealth Stats	
	Housing	*Stock market*	*Human capital*	*Bonds*	*Mean growth*	*St. Dev. growth*
High cost, $\bar{\tau}$	0.462	0.170	0.324	0.044	-0.011	0.157
Low cost, $\underline{\tau}$	0.600	0.181	0.419	-0.200	0.098	0.243

3.3 Structural changes

We consider several structural changes that could emerge as a result of financial development or policy choices. The first change increases access to credit. The second change increases access or participation to investment markets. The third change reduces the government ownership of productive capital.

Higher access to credit. Higher access to credit is obtained by increasing the collateral parameter ξ. In particular, we increase ξ so that debt over output doubles in the new steady state—from 15% to 30%. The results are reported in Table 13.

A credit expansion has both aggregate and distributional effects. It leads to an increase in aggregate production due to higher investments made by low-τ households. The higher access to credit allows these households to finance a larger share of their investments in housing, stock market and human capital with debt. As a result, more savings are invested in reproducible factors (physical and human capital), which has a positive impact on aggregate production. Since the aggregate supply of houses is fixed, the higher investment in housing increases the market price. The share of housing value in aggregate household wealth declines as physical capital increases more than the price of houses.

We look now at the composition of portfolio for low and high cost households. Remember that about 85% of households face the high cost $\bar{\tau} = 0.14$ while the remaining 15% face the low cost $\underline{\tau} = 0$. The portfolio of low-τ households contains a larger share of high return assets (housing, stock market and human capital), in part funded by debt. The heterogeneous portfolio composition of low-τ and high-τ households is important for wealth distri-

Table 13: **Higher access to credit**

	Baseline calibration			*Higher ξ*		
House price	0.172			0.180		
Output	0.082			0.088		
Debt-Output ratio	0.151			0.302		
Private capital	0.060			0.070		
Public capital	0.060			0.060		
Housing share	0.695			0.635		
Return on bonds	0.060			0.057		
Return on stocks	0.199			0.195		
Wealth distribution	Gini	0.699		Gini	0.715	
	Top 5%	0.458		Top 5%	0.481	
	Top 1%	0.277		Top 1%	0.301	
	Top 0.1%	0.135		Top 0.1%	0.153	
Portfolio composition	Housing	0.462,	0.600	Housing	0.422,	0.677
	Stocks	0.170,	0.181	Stocks	0.176,	0.225
	Human	0.324,	0.419	Human	0.312,	0.486
	Bonds	0.044,	−0.200	Bonds	0.091,	−0.388
Wealth mobility	Growth	−0.011,	0.098	Growth	−0.009,	0.086
	St. Dev.	0.157,	0.243	St. Dev.	0.143,	0.287

bution and mobility. Higher access to credit, induced by the higher value of ξ, makes the differences in portfolio composition between low-τ and high-τ households even bigger. As a result of this change, the distribution of wealth becomes more concentrated. For example, the share held by the top 1% increases from 0.277 to 0.301. This follows from the fact that low-τ households hold a more leveraged portfolio, which allows them to experience higher mean growth as well as higher volatility of growth. On the other hand, high-τ households hold a larger share of safer assets (the debt issued by low-cost households). Consequently, they experience lower volatility of growth.

In summary, a credit expansion has a positive macroeconomic impact but it generates more wealth inequality. It also increases the difference in mobility between low-τ and high-τ households: higher mobility for low-cost households and lower mobility for high-cost households.

Financial participation. Higher financial participation can be generated in two ways. The first is a reduction in $\bar{\tau}$—the investment cost for high-τ households. The second is a reduction in the fraction of households that face the high cost $\bar{\tau}$. The first change induces more participation through the intensive margin, that is, high-τ households will allocate a larger fraction of their wealth in high return assets. The second generates more participation in the extensive margin, that is, more households choose a portfolio with a larger share of high return assets. As emphasized earlier in the paper, the investment cost should be interpreted broadly. Besides actual transaction costs in financial markets, it could capture the lack of information or just aversion to more complex investment operations. With this broader interpretation, the reduction in $\bar{\tau}$ could be the result of policies that promote financial literacy in addition to the more general consequences of technological innovations in financial markets.

We start with the reduction in $\bar{\tau}$, which we reduce by half. The results are reported in Table 14.

Table 14: **Lower investment cost**

	Baseline calibration			*Lower $\bar{\tau}$*		
House price	0.172			0.355		
Output	0.082			0.226		
Debt-Output ratio	0.151			0.141		
Private capital	0.060			0.325		
Public capital	0.060			0.060		
Housing share	0.695			0.496		
Return on bonds	0.060			0.078		
Return on stocks	0.199			0.150		
Wealth distribution	Gini	0.699		Gini	0.613	
	Top 5%	0.458		Top 5%	0.366	
	Top 1%	0.277		Top 1%	0.196	
	Top 0.1%	0.135		Top 0.1%	0.080	
Portfolio composition	Housing	0.462,	0.600	Housing	0.315,	0.380
	Stocks	0.170,	0.181	Stocks	0.282,	0.390
	Human	0.324,	0.419	Human	0.367,	0.414
	Bonds	0.044,	−0.200	Bonds	0.035,	−0.184
Wealth mobility	Growth	−0.011,	0.098	Growth	−0.003,	0.048
	St. Dev.	0.157,	0.243	St. Dev.	0.121,	0.160

The lower value of $\bar{\tau}$ induces a large increase in aggregate output. The reason is that the lower investment cost increases the net returns from investing in physical and human capital for high-τ households. This encourages savings for these households. In the general equilibrium, the returns from physical and human capital (gross of the investment cost) will decline since the higher inputs of physical and human capital reduce their marginal products. However, the sensitivity of the marginal product to the supply is relatively low since physical and human capital account for 85 percent of the production inputs ($\theta_K + \theta_L = 0.85$). This implies that moderate reductions in marginal products are associated to large increases in physical and human capital, which in turn generate a large increase in production.

Since the supply of houses is fixed, the increase in physical and human capital lead to a sizable increase in the marginal product of houses, which in turn generates a large increase in their price. The increase in production and housing price would be smaller if the production share of reproducible factors was lower. For example, if human capital was not reproducible. In this case the share of reproducible factors would be $\theta_K = 0.51$ instead of $\theta_K + \theta_L = 0.85$.

The reduction in $\bar{\tau}$ leads to a less concentrated distribution of wealth. For instance, the share of wealth held by the top 1% declines from 0.277 to 0.196. This is because the differences in portfolios composition between low-τ and high-τ households become smaller. Mobility, captured by the volatility of wealth growth, decreases for both low and high-cost households.

The second way to enhance participation is by increasing the number of households that face the low investment cost (extensive margin). We can generate this by changing the transition probability matrix that governs the stochastic properties of τ.

The baseline calibration of the transition probability matrix (see Table 10) implies that about 85% of households face the high investment cost $\bar{\tau}$ while the remaining 15% face no cost ($\underline{\tau} = 0$). In the new calibration we choose a symmetric transition matrix so that in the steady state only 50% of households face the high cost $\bar{\tau}$. Specifically we change $\Gamma(\bar{\tau}, \bar{\tau})$ from 0.92 to 0.52, which is also the probability $\Gamma(\underline{\tau}, \underline{\tau})$. Results are in Table 15

The impact of increasing the number of households with low-τ is similar to lowering $\bar{\tau}$. The macroeconomic impact is positive and large for the same reasons we discussed above. The distribution of wealth becomes less concentrated because the average growth rates of wealth experienced by the two groups of households are more similar. The standard deviation of growth

Table 15: **Greater participation**

	Baseline calibration			*Lower* $\Gamma(\bar{\tau}, \bar{\tau})$		
House price	0.172			0.383		
Output	0.082			0.240		
Debt-Output ratio	0.151			0.481		
Private capital	0.060			0.348		
Public capital	0.060			0.060		
Housing share	0.695			0.438		
Return on bonds	0.060			0.014		
Return on stocks	0.199			0.150		
Wealth distribution	Gini	0.699		Gini	0.649	
	Top 5%	0.458		Top 5%	0.400	
	Top 1%	0.277		Top 1%	0.224	
	Top 0.1%	0.135		Top 0.1%	0.098	
Portfolio composition	Housing	0.462,	0.600	Housing	0.256,	0.377
	Stocks	0.170,	0.181	Stocks	0.195,	0.386
	Human	0.324,	0.419	Human	0.333,	0.422
	Bonds	0.044,	−0.200	Bonds	0.216,	−0.185
Wealth mobility	Growth	−0.011,	0.098	Growth	−0.024,	0.032
	St. Dev.	0.157,	0.243	St. Dev.	0.093,	0.156

also decreases for both groups.

To summarize, greater financial market participation—either in the intensive or extensive margins—has a positive macroeconomic impact and leads to a more equal distribution of wealth.

Privatization. A large share of Chinese businesses is under the ownership of the state. This implies that a large portion of the country's capital is not available for private investment. From the perspective of households, this reduces the variety of assets that are available for the allocation of their savings. What would be the implications of privatizing state-owned businesses?

To answer this question we compare the steady state equilibrium in the baseline calibration where half of the physical capital is held by the public sector, with the steady state equilibrium in which physical capital is held only by the private sector. Results are in Table 16.

Privatization has a negative impact on aggregate production. This can be

Table 16: **Full privatization**

		Baseline calibration			*No public capital*	
House price		0.172			0.165	
Output		0.082			0.075	
Debt-Output ratio		0.151			0.172	
Private capital		0.060			0.107	
Public capital		0.060			0.000	
Housing share		0.695			0.571	
Return on bonds		0.060			0.067	
Return on stocks		0.199			0.207	
Wealth distribution	Gini	0.699		Gini	0.654	
	Top 5%	0.458		Top 5%	0.413	
	Top 1%	0.277		Top 1%	0.238	
	Top 0.1%	0.135		Top 0.1%	0.108	
Portfolio composition	Housing	0.462,	0.600	Housing	0.406,	0.545
	Stocks	0.170,	0.181	Stocks	0.284,	0.283
	Human	0.324,	0.419	Human	0.268,	0.364
	Bonds	0.044,	−0.200	Bonds	0.043,	−0.192
Wealth mobility	Growth	−0.011,	0.098	Growth	−0.014,	0.092
	St. Dev.	0.157,	0.243	St. Dev.	0.129,	0.206

explained as follows. For the private sector to hold more capital, its return must be higher. Since the return from capital is determined by its marginal product, which is inversely related to the input of capital, the aggregate stock of capital must decline. But lower capital reduces the marginal product of houses and human capital. This has a negative impact on the price of houses and on human capital investment.

While the consequences for the aggregate economy are negative, privatization leads to a more equal distribution of wealth. One of the reasons is that households' portfolios become more diversified: they hold a smaller share of housing and a larger share of the stock market. The quantitative experiment shows that the share of housing declines from 70 percent before privatization to 57 percent. When the government owns a large share of capital, it creates shortage of stock market assets that are available to households. In equilibrium, then, households must hold more housing relatively to other assets. Since houses are risky, the individual growth rate of wealth is also more volatile. While higher volatility of wealth growth increases mobility, it also leads to a more unequal distribution.

To summarize, privatization may have a negative impact on aggregate economic activity. However, it allows for more diversified portfolios which lead to lower volatility in individual wealth growth and lower inequality.

4 Conclusion

We explored the properties of individual wealth growth and mobility in China using the China Household Finance Survey (CHFS). We emphasized three empirical findings. First, savings play a relatively minor role in explaining individual wealth mobility. Although households with higher rates of savings experience higher wealth growth, saving rate heterogeneity explains only a small portion of wealth growth heterogeneity. Instead, the most important factor is the heterogeneity in capital gains. This suggests that households' wealth is very undiversified in China.

The second finding is that housing wealth plays an important role in generating wealth mobility. This derives from two features of the Chinese economy: housing represents the largest component of households' wealth and there is significant cross-sectional dispersion in capital gains on houses. These two facts further indicate that households' wealth is very undiversified in China.

The third finding is that households' debt increases wealth mobility. Households that hold more debt (more leveraged) tend to experience greater volatility in wealth growth.

These empirical findings raise important questions. If housing ownership is so risky, why do Chinese households allocate such a large share of their portfolio in housing? If housing debt enhances mobility, should borrowing be encouraged?

To address these questions, we built a general equilibrium model with heterogeneous agents where households choose three types of assets: housing, stock market and bonds (or debt when negative). An important form of heterogeneity is the participation in high return markets. After calibrating the model to the Chinese economy, we conduct several experiments. We first relax the financial constraints faced by households. We then allow for greater participation in financial markets. Finally, we consider the privatization of state-owned businesses. The quantitative results show that greater access to credit and higher participation have positive effects on aggregate production. However, while the expansion of borrowing accessability makes the distribution of wealth more unequal, higher participation leads to a more equal distribution of wealth. Finally, we find that privatization is not necessarily beneficial for the aggregate economy but could lead to a more equal distribution of wealth.

While some of the changes considered in these experiments could be the natural consequence of financial innovations—as financial markets become more sophisticated, credit and investment markets become more accessible to the wider society—they could also be encouraged by policies. This is certainly the case for privatization. Because different changes have different implications for aggregate outcomes and wealth distribution, some changes may be more desirable than others.

A Numerical procedure

The numerical procedure consists of three steps:

1. We guess the values of the coefficients for the price function (27): $\alpha_{j,D}$, $\alpha_{i,H}$, $\alpha_{i,N}$.

2. We solve for the general equilibrium for all period $t = 1, ..., T$ as follows:

   (a) Given the states z_t, $H_{i,t}$ and $N_{i,t}$, for $i = 1, ..., I$, we guess the equilibrium prices P_t, R_{t+1} and the normalized individual decisions $\tilde{h}_{i,t+1}$, $\tilde{k}_{i,t+1}$, $\tilde{l}_{i,t+1}$, $\tilde{b}_{i,t+1}$ for each group i. Since the individual decisions are normalized by net worth $a_{i,t}$, they are the same for all households in group i (that is, all households with the same investment cost τ_t).

   (b) Using the states $H_{i,t}$, $N_{i,t}$ and the guessed price P_t, we compute the net worth for each group i,

   $$A_{i,t} = P_t H_{i,t} + N_{i,t},$$

   which we use to compute the aggregate next period variables

   $$\begin{aligned} H_{j,t+1} &= \sum_i \left(\tilde{h}_{i,t+1} A_{i,t} \right) \Gamma_{ij}, \\ K_{j,t+1} &= \sum_i \left(\tilde{k}_{i,t+1} A_{i,t} \right) \Gamma_{ij}, \\ L_{j,t+1} &= \sum_i \left(\tilde{l}_{i,t+1} A_{i,t} \right) \Gamma_{ij}, \\ B_{j,t+1} &= \sum_i \left(\tilde{b}_{i,t+1} A_{i,t} \right) \Gamma_{ij}. \end{aligned}$$

   The term Γ_{ij} is the exogenous transition probability for τ_t^i.

   (c) Now we compute the next period aggregate production inputs,

   $$\begin{aligned} H_{t+1} &= \sum_j H_{j,t+1} \\ K_{t+1} &= \sum_j K_{j,t+1} \\ L_{t+1} &= \sum_j L_{j,t+1}, \end{aligned}$$

which allows us to compute the next period returns for each realization of the aggregate shock z_{t+1},

$$\begin{aligned} r^h_{t+1} &= \theta_H z_{t+1} \bar{H}^{\theta_H - 1} K^{\theta_K}_{t+1} L^{\theta_L}_{t+1}, \\ R^k_{t+1} &= \theta_K z_{t+1} H^{\theta_H}_{t+1} K^{\theta_K - 1}_{t+1} L^{\theta_L}_{t+1} + 1 - \delta, \\ \bar{R}^l_{t+1} &= \theta_L z_{t+1} H^{\theta_H}_{t+1} K^{\theta_K}_{t+1} L^{\theta_L - 1}_{t+1} + \bar{\eta}. \end{aligned}$$

(d) At this point we have all the ingredients to compute the next period state $N_{j,t+1}$ for each group j,

$$N_{j,t+1} = r^h_{t+1} H_{j,t+1} + R^k_{t+1} K_{j,t+1} + \bar{R}^l_{t+1} L_{j,t+1}.$$

We can then use $N_{j,t+1}$ with the guessed price function for housing to compute the next period price for each realization of z_{t+1},

$$P_{t+1} = \sum_j^J \alpha_{j,D} D_{j,t+1} + \sum_{i=1}^{I-1} \alpha_{i,H} H_{i,t+1} + \sum_{i=1}^{I} \alpha_{i,N} N_{i,t+1}.$$

(e) Next we check the accuracy of the initial guesses for the individual decisions and the prices P_t and R_{t+1} we made in step 2(a). We do so by verifying

- The first order conditions for individual decisions (equations (22)-(26)) for each $i = 1, ..., I$.
- The market clearing conditions for housing, $\sum_i^I H_{i,t+1} = 1$, and for bonds, $\sum_i B_{i,t+1} = 0$.

These conditions are used to update the initial guesses and restart the procedure from step 2(b) until the approximation error is negligible. We use a nonlinear solver for this step.

3. Once we have the solutions for $t = 1, ..., T$, we estimate the parameters of the price function (27)—$\alpha_{j,D}$, $\alpha_{i,H}$, $\alpha_{i,N}$—by regression using the data generated for the T periods. The estimated parameters are then used to update the guesses for the parameters of the price function. The whole procedure is repeated until the estimated parameters as sufficiently closed to the guessed parameters.

B Additional Tables and Figures

Table 17: **Wealth mobility matrices for whole sample and sub-samples with housing debt and multiple houses. Linked surveys 2011-2013 and 2013-2015.**

Whole sample (2011-2013)			
	Bottom	Middle	Top
Bottom	74.3%	24.4%	1.3%
Middel	20.8%	55.8%	23.4%
Top	5.1%	11.4%	83.6%

With housing debt (2011-2013)			
	Bottom	Middle	Top
Bottom	61.9%	37.7%	0.4%
Middle	21.7%	45.5%	32.8%
Top	0.8%	10.9%	88.3%

With multiple houses (2011-2013)			
	Bottom	Middle	Top
Bottom	65.5%	34.5%	0.0%
Middle	17.7%	56.6%	25.7%
Top	3.0%	11.2%	85.8%

Whole sample (2013-2015)			
	Bottom	Middle	Top
Bottom	78.7%	18.5%	2.8%
Middel	29.1%	53.8%	17.2%
Top	6.1%	19.0%	75.0%

With housing debt (2013-2015)			
	Bottom	Middle	Top
Bottom	75.7%	21.2%	3.1%
Middle	29.4%	50.8%	19.8%
Top	5.2%	17.8%	77.0%

With multiple houses, (2013-2015)			
	Bottom	Middle	Top
Bottom	77.3%	18.0%	4.7%
Middle	27.4%	56.8%	15.8%
Top	3.9%	16.1%	80.0%

Table 18: **Household Characteristics (1)**

	obs	wealth at t	wealth at $t+1$	income at t	income at $t+1$	consum at t	consum at $t+1$	debt at $t+1$	debt at $t+1$
					2015-2017				
All	15,742	890,997	1,013,665	73,100	89,225	58,144	60,188	36,686	49,268
q1	3,111	915,890	182,634	59,240	55,337	52,850	45,499	33,683	45,398
q2	3,068	1,010,162	700,397	76,971	79,975	59,772	56,967	30,134	37,999
q3	2,969	974,514	1,054,948	81,521	95,537	60,233	63,399	31,987	39,323
q4	3,300	963,200	1,445,491	79,184	105,007	61,387	66,399	40,103	54,123
q5	3,294	591,226	1,684,440	68,585	110,261	56,479	68,675	47,514	69,487

Note: sorted by the growth rate of wealth

Table 19: **Household Characteristics (2)**

	obs	age	2-home owner	1-home owner	entrepr-eneur	college	tier-1 cities	house price rider	house buyer
					2015-2017				
All	15,742	50.57	21.06%	71.82%	9.16%	12.89%	8.99%	17.30%	15.57%
q1	3,111	53.06	7.82%	70.40%	8.51%	6.26%	7.94%	2.54%	6.84%
q2	3,068	50.68	16.35%	79.92%	9.92%	11.05%	5.27%	3.94%	8.84%
q3	2,969	50.80	21.81%	75.60%	8.96%	15.31%	6.84%	7.21%	10.79%
q4	3,300	49.65	26.86%	69.90%	8.20%	16.08%	12.19%	27.17%	17.22%
q5	3,294	48.64	32.47%	63.31%	10.21%	15.73%	12.70%	45.62%	34.13%

Note: sorted by the growth rate of wealth
Dummy variables at time $t+1$: 2-home owners, 1-home owners, entrepreneurship, college, tier-1 cities, house price riders, house buyers.

Table 20: **Wealth growth, sorting by the demographics**

	obs	g_{wt}	g_t	s_t	r_{wt}	r_{lt}	r_{kt}
				2013-2015			
Marriage status							
Single	2,234	8.2%	4.8%	19.4%	17.1%	8.2%	8.9%
Married	10,617	12.6%	7.3%	27.9%	19.0%	9.2%	9.8%
Education level							
Secondary and below	6,005	4.6%	2.2%	13.7%	17.6%	7.1%	10.5%
High school and equivalent	4,846	12.4%	7.2%	27.8%	18.7%	9.0%	9.7%
Bachelor and above	1,965	19.6%	11.7%	39.1%	20.2%	11.5%	8.8%
Age group							
Below 25	473	10.1%	7.4%	15.7%	17.4%	10.3%	7.0%
25-34	2,361	17.3%	10.2%	31.3%	22.6%	13.0%	9.5%
35-44	3,072	15.2%	9.8%	26.1%	20.8%	11.8%	9.1%
45-54	2,916	12.5%	8.0%	25.2%	18.0%	9.9%	8.1%
55-64	2,006	5.1%	1.3%	25.6%	14.7%	4.9%	9.9%
65 and above	2,023	5.7%	1.3%	27.6%	15.6%	0.9%	14.7%
				2015-2017			
Marriage status							
Single	2,862	3.9%	-1.1%	29.4%	17.2%	8.1%	9.1%
Married	12,880	13.4%	7.2%	31.7%	19.6%	9.4%	10.1%
Education level							
Secondary and below	7,984	4.2%	0.6%	19.4%	18.1%	7.6%	10.6%
High school and equivalent	5,567	11.7%	5.5%	32.9%	18.8%	8.8%	10.0%
Bachelor and above	2,185	26.1%	16.0%	45.9%	21.9%	12.9%	9.0%
Age group							
Below 25	330	-10.8%	-18.3%	37.7%	19.9%	11.9%	8.0%
25-34	2,356	17.7%	8.3%	39.1%	24.1%	14.6%	9.5%
35-44	3,249	19.8%	13.0%	30.8%	22.1%	12.2%	10.0%
45-54	3,782	12.5%	6.7%	30.3%	18.9%	10.8%	8.1%
55-64	2,798	8.2%	3.7%	28.0%	16.2%	6.0%	10.1%
65 and above	3,227	2.4%	-1.5%	26.9%	14.5%	1.0%	13.5%

Table 21: **Wealth growth across households (by initial wealth).**

	obs	g_{wt}	g_t	s_t	r_{wt}	r_{lt}	r_{kt}
				2011-2013			
All	3,705	19.4%	14.4%	26.8%	18.9%	11.9%	7.0%
q1	682	95.1%	80.3%	11.9%	124.2%	81.2%	43.0%
q2	701	74.8%	64.3%	19.9%	53.0%	35.0%	17.9%
q3	755	52.1%	44.8%	21.9%	33.7%	22.3%	11.4%
q4	827	42.7%	35.7%	28.7%	24.3%	14.0%	10.3%
q5	740	2.2%	-1.3%	34.7%	10.2%	6.4%	3.8%
				2013-2015			
All	12,851	11.8%	7.2%	24.8%	18.5%	11.5%	7.1%
q1	2,811	123.7%	116.5%	8.2%	88.0%	52.4%	35.6%
q2	2,425	52.3%	44.6%	19.1%	40.7%	25.2%	15.5%
q3	2,328	26.4%	20.0%	22.2%	29.1%	17.7%	11.3%
q4	2,393	20.3%	14.8%	26.9%	20.7%	12.6%	8.1%
q5	2,894	-2.8%	-6.2%	32.2%	10.6%	6.8%	3.8%
				2015-2017			
All	15,742	13.8%	8.0%	30.0%	19.1%	11.8%	7.3%
q1	3,134	83.8%	77.2%	7.6%	86.5%	51.9%	34.6%
q2	2,836	42.4%	32.3%	23.2%	43.1%	26.0%	17.1%
q3	2,837	23.3%	15.0%	27.3%	30.4%	18.9%	11.5%
q4	3,106	22.5%	15.6%	32.0%	21.5%	13.2%	8.3%
q5	3,829	3.5%	-0.9%	38.7%	11.3%	7.1%	4.2%

Table 22: **Wealth growth across households (by average wealth).**

	obs	g_{wt}	g_t	s_t	r_{wt}	r_{lt}	r_{kt}
			2011-2013				
All	3,705	19.4%	14.4%	26.8%	18.9%	11.9%	7.0%
q1	679	-9.5%	-16.2%	7.7%	88.0%	51.9%	36.1%
q2	701	18.5%	9.0%	20.5%	46.4%	32.3%	14.1%
q3	766	25.8%	19.8%	19.0%	31.9%	21.2%	10.7%
q4	837	26.0%	20.3%	25.4%	22.4%	13.8%	8.7%
q5	722	17.4%	13.1%	37.6%	11.4%	6.9%	4.5%
			2013-2015				
All	12,851	11.8%	7.2%	24.8%	18.5%	11.5%	7.1%
q1	2,840	-3.7%	-7.6%	5.9%	65.3%	40.2%	25.0%
q2	2,441	4.0%	-1.3%	15.7%	34.1%	21.0%	13.1%
q3	2,286	10.4%	4.0%	23.0%	27.4%	17.7%	9.7%
q4	2,377	12.6%	7.2%	26.1%	20.5%	12.5%	8.0%
q5	2,907	13.5%	9.6%	33.3%	11.6%	7.2%	4.5%
			2015-2017				
All	15,742	13.8%	8.0%	30.0%	19.1%	11.8%	7.3%
q1	3,106	-32.8%	-33.9%	1.8%	58.7%	33.5%	25.2%
q2	2,807	-12.8%	-20.2%	20.4%	36.2%	22.4%	13.9%
q3	2,856	0.2%	-7.2%	26.0%	28.4%	18.0%	10.4%
q4	3,117	8.3%	1.2%	32.9%	21.4%	13.4%	7.9%
q5	3,856	24.1%	19.1%	39.7%	12.4%	7.6%	4.8%

Table 23: **The growth rate of each asset component**

	obs	asset	hs-asset	fin-asset	bus-asset	oth-asset	debt	hs-debt
				2013-2015				
all	12,851	12.47%	12.78%	40.00%	48.07%	-25.80%	19.82%	16.05%
q1	2,749	-61.36%	-58.24%	-45.49%	-49.32%	-65.30%	39.18%	30.15%
q2	2,520	-15.85%	-12.90%	-6.74%	1.38%	-42.50%	10.31%	12.02%
q3	2,459	10.51%	10.20%	35.32%	19.61%	-21.59%	3.87%	1.06%
q4	2,542	46.79%	39.81%	98.12%	139.99%	1.80%	2.93%	-4.59%
q5	2,581	176.06%	173.29%	165.68%	305.80%	32.60%	47.55%	56.79%
				2015-2017				
all	15,742	14.83%	18.83%	17.38%	-31.07%	9.91%	34.30%	39.65%
q1	3,111	-75.00%	-77.54%	-51.10%	-77.97%	-49.81%	34.78%	31.53%
q2	3,068	-28.58%	-25.40%	-28.89%	-55.81%	-21.19%	26.10%	37.20%
q3	2,969	8.58%	10.62%	9.68%	-25.78%	12.68%	22.93%	28.77%
q4	3,300	49.47%	51.09%	49.63%	1.87%	43.43%	34.96%	35.90%
q5	3,294	173.50%	173.20%	127.19%	91.84%	97.66%	46.25%	54.17%

Note: sorted by the growth rate of wealth
Variables: total assets, house assets, financial assets, business assets, other assets, total debt, house debt.

Table 24: The way households obtained their houses (from 2017 survey)

	Freq.	Percent
1, purchased, new	5,680	24.95
2, purchased, second hand	3,102	13.62
3, purchased, policy housing	944	4.15
4, inherited	974	4.28
5, welfare housing	2,891	12.7
6, public funding housing	418	1.84
7, self-constructed	6,335	27.83
8, resettlement housing	1,884	8.28
9, purchased, limited property right	274	1.2
10, others	265	1.16
Total	22,767	100

Note: Type 1&2 are typical commercial housing, which has a fair market price. Type 7 are households who were previously rural households and now became urban households. The house price in Figure 2 are calculated based on Type 1&2 houses.

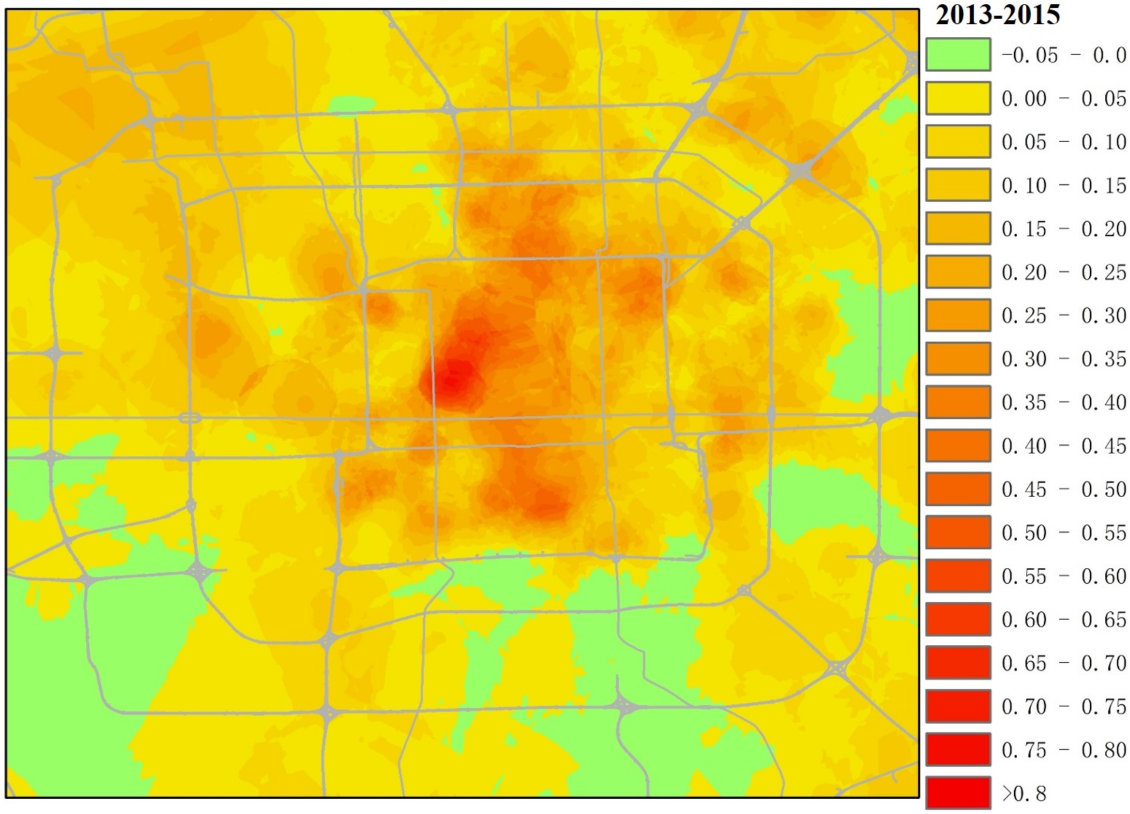

Figure 1: **Community level house price growth rate in Beijing (from transaction data of Lianjia)**

This figure presents the two-year housing price growth rate during the period 2013-2015 across communities in the city of Beijing. Warn color means positive growth rate, while green color represents negative growth. The grey circles represent the highways of Beijing. The data is from the largest real-estate brokerage company Lianjia (like Zillow in US). In 2015, there were around 70,000 housing transactions across 3,000 communities in Beijing. Based on the transaction data, we first calculate the average housing price for each community and then compute the two-year growth rate.

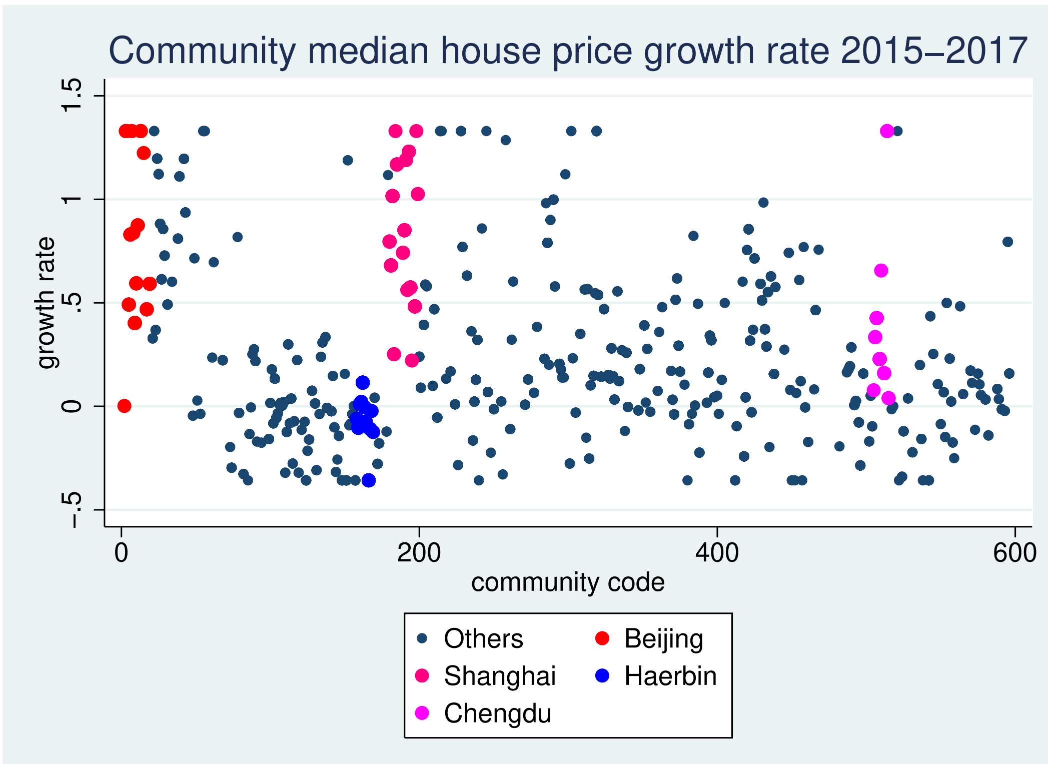

Figure 2: **Community level median house price growth rate (calculated from our data sample)**

This figure presents the two-year housing price growth rate during the period 2015-2017 across communities in our survey data sample. The y-axis represents the two-year growth rate of housing price, and the x-axis represents the community code. Each dot represents a community. We also mark the communities in four selected cities with different colors. For example, we used the red color to denote Beijing, and the blue color to denote Haerbin, a city in northeast of China. We first calculate the median housing price for each community and then compute the two-year growth rate.

C Compared to the CFPS data

Here, we compare the statistics from the two survey data CHFS and CFPS. Both samples include the rural households. They are all full sample.

Table 25: **Sorted by the growth rate of net worth (CHFS data)**

	obs	g_w	g	s	r_w	r_l	r_k
all	25280	14.52%	8.09%	29.92%	21.51%	10.63%	10.89%
q1	5067	-86.64%	-88.79%	15.90%	13.48%	6.17%	7.31%
q2	5008	-39.04%	-43.65%	27.17%	16.95%	8.06%	8.89%
q3	4807	6.20%	-0.33%	32.43%	20.13%	9.89%	10.24%
q4	5168	58.54%	50.26%	34.76%	23.82%	12.38%	11.43%
q5	5230	248.52%	233.34%	33.60%	45.20%	22.52%	22.68%

Table 26: **Sorted by the growth rate of net worth (CFPS data)**

	obs	g_w	g	s	r_w	r_l	r_k
all	9104	16.95%	11.09%	16.34%	35.86%	19.65%	16.22%
q1	1846	-81.61%	-84.10%	8.98%	27.73%	15.48%	12.24%
q2	1810	-35.34%	-39.43%	13.45%	30.37%	16.66%	13.72%
q3	1770	4.25%	-0.49%	14.44%	32.84%	18.75%	14.09%
q4	1865	56.10%	50.02%	18.55%	32.80%	18.36%	14.45%
q5	1813	248.46%	230.87%	23.40%	75.19%	38.18%	37.01%

1. CHFS data is 2015-2017, and CFPS data is 2014-2016.
2. The distributions of wealth growth g_w are quite similar in the two dataset.
3. The saving rate of CHFS is higher than that of CFPS. This is due to the under reported income level in CFPS.

D Compared to the SCF data

In 2009, the Federal Reserve Board (FRB) designed and implemented a follow-up survey of families that had participated in the then most recent wave of the Survey of Consumer Finances (SCF) in 2007. So, for the 2007-2009 survey, it is a panel, and therefore we can calculate the household-level wealth growth rate and do the same exercise as in our paper.

The growth rate of net worth in the SCF data is also quite volatile. However, it is the period of financial crisis. So, the average growth of net worth is negative. But for the top group, it is quite high: 116.8%.

Table 27: **Sorted by the growth rate of net worth (SCF 2007-2009 panel survey)**

	g_w
all	-25.64%
q1	-81.11%
q2	-48.75%
q3	-22.20%
q4	4.61%
q5	116.8%